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FERMENTED ASHITABA TEA LEAVES AS A NUTRITIOUS BEVERAGES: A PRODUCT INNOVATION

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Abstract. In Industrial Revolution 4.0 era, a company needs to have a sustainable competitive advantage due to the intense and rapid competition. The customers are very demanding for a health-promoting beverage with improved functionality, so developing products capability as an innovation strategy can increase competitiveness. Ashitaba (Japanese celery plant) is a herbal plant that has many benefits to relieve diabetes, heart disease, and other diseases. Fermentation process had increased the health benefits and the pleasant flavour of beverage. Quality fermented beverage product contains antioxidant and sensory as fermented ashitaba tea leaves was evaluated then compare with the original. Key Performances Indicators/KPIs represents an important tool for assuring that the objectives of innovation are optimized. For the result, final fermented beverages called a Kombucha, has higher antioxidant capacity than Ashitaba tea leaves. The production of organic acids and metabolic compound has decreased the bitterness, increased sweetness, and increased appearance of fermented ashitaba leaves tea compare with ashitaba leaves tea. Fermenting ashitaba tea leaves can improve the product quality and acceptability.

1. INTRODUCTION

Indonesia is known as one of the largest tropical countries in the world which has the potential as a producer of world medicinal plants. One of them is Ashitaba or Japanese Celery. Ashitaba is a rare plant that thrives in Trawas, Mojokerto Regency which is cultivated organically by the Trawas community to be processed into herbal products and treatments that are efficacious to prevent and cure certain diseases such as tumors, diabetes, heart disease and others. Currently the Ministry of Agriculture is focusing on developing programs for the cultivation of vegetables, fruit, ornamental plants and medicinal plants to meet the domestic and export markets so that the welfare of farmers continues to increase. The Ministry of Agriculture spurred the cultivation of medicinal plants and the production of finished products not only to meet their own needs but also targeted for export. This is important for the welfare of farmers and the addition of foreign exchange.The main raw materials used are Ashitaba plants includes leaves, stems, roots and sap which are cultivated by Trawas farmers.

Indonesia produces and exports many agricultural products in the form of raw materials and imports its processed products. In the long run this is very detrimental to domestic producers because of the loss of added value. The profit margin for processed products is greater than selling raw materials and semi-finished goods. Indonesia's commodity competitiveness is weak because it still relies on the comparative advantage of abundance of natural resources and less educated workforce. The resulting product is dominated by primary products that are natural or resource based and unskilled labor intensive. Today's market dynamics demand modern processed products for consumer needs, which cause the lack of need for traditional processed products from the community. To that end, Indonesia's agricultural development policy must step towards to industrialization through the

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development of processed products, where the export of agricultural products must gradually switch from primary products to processed products and at the same time reduce imports of processed products. The development of processed products has multiple advantages such as export promotion and import substitution, creating added value, creating industrial employment, and increasing technology adoption. The development of the agricultural processing industry must have a competitive and comparative advantage and be supported by the availability of quality and continuity of raw materials which will be processed.

The world is now entering the era of the industrial revolution 4.0. The industrial revolution 4.0 is characterized by a variety of applied technologies and distributed manufacturing which is able to change production patterns and business models in various industrial sectors. Rapid development in information technology has become the basis in human life. All things become borderless with the use of unlimited computing and data technology resources that are influenced by the development of the internet and massive digital technology as the backbone of the movement and connectivity of humans and machines**.** Global competition is becoming increasingly fierce in the era of the Industrial Revolution 4.0, so there is a need for innovation. Indonesian Ministry of Research, Technology and Higher Education said that the challenge of a country to become a developed country has shifted, no longer measured by the amount of natural resources owned but by how much the amount of innovation that can be produced to drive the country's economic growth.

According to Sam (2011), innovation is essential to gain competitive advantage and create value, and its outcomes can be both tangible (e.g., new products, designs, expertise) and intangible (e.g., new processes and ways of conducting business). Product innovation could be a differentiate major success factor in today’s aggressive and competitive food markets (Suwannaporn, 2010). Currently Ashitaba processed products are still limited to tea. Ashitaba is a commodity that can still be developed by innovation to be more varied. To make Ashitaba or Japanese celery as a value-added product, it is proposed to make kombucha.

The purpose of this paper is to emphasize the importance of innovation by using KPIs as a measurement tool.Ashitaba tea leaf beverage products that are fermented will be formulated then evaluated using KPIs for optimization of product innovation planning.

2. METHODS

Specific methodologies are needed to identify product innovations that meet the indicators so that they are useful for accurate decision making. Tools for product innovation is carried out with 2 tests: (1) antioxidant activity and (2) descriptive sensory analysis. After conducting the two tests, the next method is to use the Key Performance Indicators (KPIs) as an important tool to ensure that the innovation goals are optimized.

Ashitaba leaves powder with 120 mesh particle size was prepared before then ashitaba leaves was taken from Trawas, Mojokerto. The research was conducted on the kombucha based on Ashitaba tea leaves and control samples of Ashitaba tea. The kombucha fermentation process was followed based on Gramza-Michalowska et al‘s method (2016) with slight modifications. Four grams of ashitaba tea leaves powder (after dried at 60^{o}C in cabinet dryer) were added to 1 L of boiling distilled water and allowed to infuse for 10 min then added sucrose 80 g. The infusion was left to cool (30±2^{o}C), then filtered. After filtered, ashitaba leaves tea poured into sterile jars with lids and kept protected from sunlight. The next step is the fermentation process for 8 days 28±2^{o}C followed by adding kombucha layer (SCOBY). The control samples (Ashitaba tea) were followed to the same procedure but no need SCOBY (Fig 1).

To calculate antioxidant capacity, kombucha ashitaba were stored for eight days. Prior to the assessment of DPPH radical scavenging assay, the samples were filtered then centrifuged (5 min, 2000 rpm) and the supernatant was collected The pH evaluation of kombucha tea was evaluated using a pH meter. The DPPH procedure described by Michalowska et al ‘s method (2016) based on the

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absorbance decrease of DPPH solution (2,2-diphenyl-1-picrylhydrazyl) at λ = 515 nm in the presence of antioxidants. The percent of antioxidant activity (%inhibition) was measured using this formula :

$$\text{Inhibition (\%)} = \frac{\text{Absorbance of control} - (\text{absorbance of sample} - \text{blank})}{\text{Absorbance of control}} \times 100$$

Descriptive sensory evaluations were achieved for Kombucha using five trained panellists. The screening procedure to obtain panellists was followed on Meilgaard et al (1999). The trained panellist was elaborated to generate lexicon to evaluate kombucha ashitaba which consist of overall acceptability, smoothness, clarity, consistency, colour, taste and aroma attributes using a 0-15 scale. Data analyses were performed using one tailed T-test. All statistical then evaluate with IBM SPSS Statistic 24 (SPSS Inc, USA).

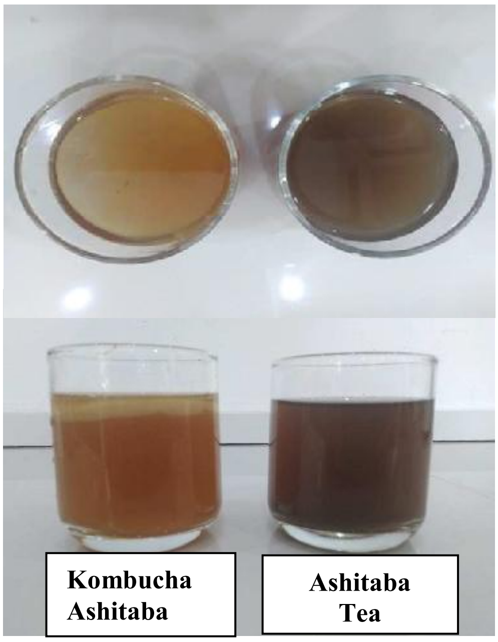

Fig 1. Ashitaba tea and Kombucha Ashitaba tea with SCOBY

3. Result and Discussion

The effect of fermentation process on Ashitaba tea leaves can increase the antioxidant activity (% inhibition of radical DPPH). Based on the data, there is a significant difference in the percentage of antioxidant activity (Table 1). The differences in DPPH radical scavenging capacity due to by the initial polyphenol content of ashitaba tea. The polyphenol of ashitaba tea was changing in fermenting process. However, Chu and Chen (2006) revealed that phenol content might not conclude the antioxidative potential of kombucha, whereas the metabolites of kombucha produced play an essential role such as gluconat acid.

Table 1. Antioxidant activity of beverages based on Ashitaba leaves

Parameter	Ashitaba tea	Kombucha Ashitaba tea
Antioxidant activity (% inhibition)	$60.14^{a}\pm2.34$	$77.93^{b}\pm0.97$

Note: Different letter notations behind the mean in each row indicate a significant difference based on T-test with a P-value of 0.05. *Ascorbic acid as positive control. The antioxidant activity of ascorbic acid was 90.06%

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DPPH radical scavenging capacity reduced at a slow rate in incubation time of fermentation process. Mester and Tien (2000) advised that the enzymes produced during the fermentation process was cut aromatic hydrocarbons in non-specific, radical-based oxidation, which could result in the appearance of more hydrophilic components. The antioxidant activity of kombucha ashitaba tea is due to the existence of tea polyphenols and ascorbic acid. Furthermore, Bacteria and yeast enzymes was producing a low-molecular-weight component and the structural modification of polyphenols. The activity depended upon the tea material used, fermentation time, and microorganism of the kombucha culture. Yellow brownish colour contains a higher number of biologically active substances (Jayabalan et al., 2008; Malbaša et al., 2011).

Table 2. Descriptive sensory analysis of beverages based on Ashitaba leaves

Attributes		**Beverages based on Ashitaba leaves**	
		Pure Tea	**Kombucha**
Appearance	Overall acceptability	3.88[a]	12.97[b]
	Smoothness	3.75[a]	9.79[b]
	Consistency	4.97[a]	9.09[b]
	Clarity	2.35[a]	12.65[b]
Color	Greenish color	14.08[b]	3.44[a]
	Brownish color	7.85[a]	13.9[b]
Taste	Sourness	2.67[a]	10.8[b]
	Astringent	7.9[b]	3.69[a]
	Bitterness	8.47	1.32[a]
	Green tea like	3.33[a]	5.64[b]
Aroma	Sourness	3.45[a]	9.7[b]
	Beer/fermented	2.11[a]	8.73[b]
	Sweetness	2.05[a]	7.59[b]
	Grassy like	13.21[b]	4.31[a]

Note : The scale ranging from 0 – 15 (low to high). Different letter notations behind the mean in each row indicate a significant difference based on T-test (P-value <0.05)

Sensory evaluation was performed in descriptive analysis of beverages based on ashitaba leaves showed that different significantly. The highest overall acceptability, consistency, clarity and smoothness were evaluated (Table 2). Clarity scores in appearance of kombucha ashitaba which might have been the result of Acetobacter xylinum producing a fibrous structure. The taste of kombucha samples were evaluated base on the kind of tea leaf used for the kombucha fermentation process. Acetic acid bacteria produce acid, which is acknowledged as a sourness taste in kombucha. The bitter taste was reduced by the kombucha layering activity during the fermentation process, since it produces amino acids reducing the bitterness of the alkaloid compound of tea. The acidic substance maintains a balance in kombucha, giving an abundant flavour, graded as sour and beer. Kombucha tea brews also differed with regard to aroma intensity. The colour was evaluated and showed that kombucha more have yellow brownish colour than pure tea ashitaba. Malbaša et al.(2011) also suggested the differences in the kombucha samples, and described them as being a light brown colour, sour and sparkling drink.

Table 3 describes a correlation between objectives, expected results and KPIs. the planning stages of innovation with the tests that have been carried out on kombucha analysed with the correlation of objectives, results and measurements in accordance with the specified KPIs. Based on table 3, the product innovation tests conducted are in accordance with the KPIs. The objectives, results and measurements carried out as a planning for making kombucha are expected to improve the quality and performance of the product.

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Table 3. Key Performance Indicators/ KPIs description

No.	Objectives	Results	KPI	Measurement
1.	Fermenting Ashitaba leaves tea powder with optimum condition for making a Kombucha as development nutritious beverages	Kombucha Ashitaba Leaves tea with higher antioxidant activity than ashitaba leaves tea for innovative product based on ashitaba powder	Increasing high quality Fermenting Ashitaba leaves tea powder based on increased nutrition in Kombucha Ashitaba compared to ashitaba tea.	Measuring the antioxidant activity of Kombucha Ashitaba leaves tea in comparison with Ashitaba leaves tea (without fermentation process) Analyze the antioxidant activity of kombucha ashitaba using DPPH analysis method
2	Identification of sensory analysis of kombucha ashitaba for overall acceptance of consumer compare with ashitaba tea	Kombucha ashitaba increase the sourness and decreased the bitterness of the taste and aroma t ashitaba tea. Fermenting ashitaba also increasing the overall acceptability of ashitaba tea (without fermentation)	Increasing high performance of kombucha ashitaba based on acceptability of kombucha compared to ashitaba tea.	Describe the attributes of sensory performance (appearance, colour, taste, aroma) using descriptive sensory analysis method then compare with specific attributes of ashitaba leaves tea. Specific attributes are needed to analyse important attributes of kombucha and ashitaba tea for acceptability of the product

4. CONCLUSION

Innovation through the creation and use of knowledge has been recognized as a major driver of economic growth. The intense competition in the 4.0 industrial revolution caused the agricultural industry especially Ashitaba need to adapt well to be able to win the competition. Processed product innovation needs to be done so that Ashitaba has added value and has a greater margin so that it can provide welfare for Ashitaba community in Trawas, Mojokerto.

Development of food products are very dependent on consumer perception and acceptance. Kombucha as a processed innovation product from Ashitaba is expected to be accepted by consumers. Kombucha has higher antioxidant activity than Ashitaba tea leaves. The production of organic acids and metabolic compound may increase the sourness of taste and aroma also decreased the bitterness of kombucha ashitaba leaves tea. Fermenting ashitaba tea leaves can improve the product quality and acceptability.

The methodology for developing KPIs is applied to product innovation with the aim of optimizing it by setting steps to systematically achieve process objectives. In conclusion, quality improvement as a result of product innovation in the form of kombucha and improvement in kombucha performance illustrate that innovation planning has been carried out optimally.

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